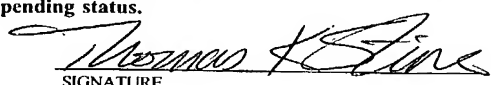


JC05 Rec'd PCT/TO 02 APR 2002

FORM PTO-1390 (REV. 12-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				328 P 653	
				U.S. APPLICATION NO. (If known, see 37 CFR 1.51)	
10/089861					
INTERNATIONAL APPLICATION NO. PCT/US00/27522		INTERNATIONAL FILING DATE 6 October 2000		PRIORITY DATE CLAIMED 7 October 1999	
TITLE OF INVENTION ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SHOCK-WAVES					
APPLICANT(S) FOR DO/EO/US Paris TSANGARIS, Thomas F. LONGWELL, Thomas E. MILLER, Dennis Ray KIRCHHOEFER and Daniel M. WARREN					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371</p> <p>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input type="checkbox"/> has been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>a. <input type="checkbox"/> is attached hereto</p> <p>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input type="checkbox"/> have been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input checked="" type="checkbox"/> have not been made and will not be made</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3))</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1821 - 1825</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: Transmittal of International Search Report; Transmittal of International Preliminary Examination Report</p>					

JC13 Rec'd PCT/PTO 02 APR 2002

U.S. APPLICATION NO. 10/089861 INTERNATIONAL APPLICATION NO. PCT/US00/27522		ATTORNEY'S DOCKET NUMBER 328 P 653																										
21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. \$1040.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =		CALCULATIONS PTO USE ONLY																										
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		\$ 890																										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">CLAIMS</th> <th style="width: 20%;">NUMBER FILED</th> <th style="width: 20%;">NUMBER EXTRA</th> <th style="width: 20%;">RATE</th> <th style="width: 20%;">\$</th> </tr> </thead> <tbody> <tr> <td>Total claims</td> <td>38 - 20 =</td> <td>18</td> <td>x \$18.00</td> <td>\$ 324</td> </tr> <tr> <td>Independent claims</td> <td>6 - 3 =</td> <td>3</td> <td>x \$84.00</td> <td>\$ 252</td> </tr> <tr> <td colspan="4">MULTIPLE DEPENDENT CLAIM(S) (if applicable)</td> <td>+ \$280.00</td> </tr> <tr> <td colspan="4">TOTAL OF ABOVE CALCULATIONS =</td> <td>\$ 706</td> </tr> </tbody> </table>		CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	Total claims	38 - 20 =	18	x \$18.00	\$ 324	Independent claims	6 - 3 =	3	x \$84.00	\$ 252	MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ \$280.00	TOTAL OF ABOVE CALCULATIONS =				\$ 706	\$ 130	
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a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>1726.00</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees A duplicate copy of this sheet is enclosed c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>23-0280</u> . A duplicate copy of this sheet is enclosed. d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038																												
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.																												
SEND ALL CORRESPONDENCE TO Thomas K. Stine, Esq. WALLENSTEIN & WAGNER, LTD. 311 South Wacker Drive - 5300 Chicago, IL 60606 312-554-3300																												
SIGNATURE  Thomas K. Stine NAME 32,310 REGISTRATION NUMBER																												

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TRANSDUCER WITH RESISTANCE TO SHOCKDESCRIPTIONRelated Applications

This application claims priority to U.S. Provisional Patent Application entitled "Transducer With Resistance To Lateral Shock," Serial No. 60/158572, filed October 7, 1999 and U.S. Provisional Patent Application entitled "Transducer With Resistance To Shock," Serial No. 60/180547, filed February 7, 2000. Both applications and U.S. Patent No. 5,647,013, entitled "Electrostatic Transducer," issued July 8, 1997, are incorporated herein.

Technical Field

This invention relates to a transducer, suitable for use within hearing aids, for reducing shock.

Background of the Invention

It is known that transducers include a coil with a first air gap or tunnel, magnetic members, such as spaced apart permanent magnets, having a second air gap or tunnel, and a reed armature. The first and second air gaps are generally aligned, with the armature reed extending through the first and second air gaps.

The arrangement is such that when the moving part of the reed shifts in one direction or another away from a centralized position between the two poles, the magnetic flux is caused to flow in one direction or the other along the reed and hence through the coil. The reed is attached to a diaphragm and in this way the vibrations of the diaphragm caused by received sound are converted into corresponding currents in the coil or vice versa. If the transducer experiences a shock e.g., from being dropped, the reed can be easily damaged due to over deflection or unwanted deflection in the horizontal and/or vertical directions. In addition, the tip portion of the reed may strike the magnet with considerable force

on the upper or lower side walls of the tunnel formed within the coil. Reference can be made to U.S. Patent No. 5,647,013 for one such arrangement.

To reduce and prevent unwanted deflection of the armature's reed, the tunnel of the transducer can be tapered (inwardly or outwardly) from the fixed or stationary end of the armature toward the deflection end of the reed. In addition, a contact point can extend into the tunnel to reduce or prevent unwanted horizontal deflection of the armature reed. These previous techniques still require the reed to contact the surface of the tunnel and this contact can cause damage to the reed.

This invention is designed to prevent these and other problems.

Summary of the Invention

According to a first embodiment of the present invention, a transducer resistant to shock comprises a stack having a pair of spaced magnets at least partially forming a tunnel. The tunnel has a central axis and the magnets have an upper and a lower tunnel wall. A coil at least partially forms the tunnel. The coil has a first and a second side wall and an upper and lower wall. Extending through the tunnel is a reed having a central portion, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets. The reed is mounted for deflection towards or away from the magnets. A shock protective means is responsive to a shock impulse to the transducer where upon the protective means engages the reed. Preferably, the shock protective means comprises a ring fixedly attached between the coil and the stack. At least one bumper is attached to the ring in close proximity to the reed wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.

Another embodiment of the present invention is directed to a transducer comprising a pair of spaced magnets at least partially forming a tunnel. The tunnel has a central axis. A coil having a first and a second side wall and an upper and

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Brief Description of the Drawings

FIGURE 1 is front view of the present invention;

FIGURE 2 is a rotated top view of the present invention shown in

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FIGURE 3 is an enlarged view of FIGURE 1;

FIGURE 4 is an enlarged view of FIGURE 2;

FIGURE 5 is a cut-away side view of the present invention;

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FIGURE 7 along the line 8-8;

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FIGURE 10 is a side cut-away view of a portion of the present invention;

FIGURE 11 is a view of one embodiment of a magnet of the present invention;

5 FIGURE 12 is a partial side cut-away view of an alternative embodiment of the present invention;

FIGURE 13 is a partial side cut-away view of an alternative embodiment of the present invention;

10 FIGURE 14 is a partial side cut-away view of an alternative embodiment of the present invention;

FIGURE 15 is partial view of a magnet of an alternative embodiment of the present invention;

FIGURE 16 is partial view of a magnet of an alternative embodiment of the present invention;

15 FIGURE 17 is a front view of an alternative embodiment of the present invention;

FIGURE 18 is a front view of an alternative embodiment of the present invention;

20 FIGURE 19 is a front view of an alternative embodiment of the present invention;

FIGURE 20 is a front view of an alternative embodiment of the present invention;

FIGURE 21 is a side view of an alternative embodiment of the present invention;

25 FIGURE 22 is a side view of an alternative embodiment of the present invention; and,

FIGURE 23 is a front view of an alternative embodiment of the present invention.

Detailed Description

5 While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the
10 embodiments illustrated.

Figure 1 is a front view of a transducer 2 with its housing 4 (see Figures 17 and 18) removed. Figure 2 is a top/rotated view of the transducer of Figure 1. Figure 3 is an enlarged view of Figure 1, and Figure 4 is an enlarged view of Figure 2. Figure 5 is a cut-away side view of the transducer of Figure 1.

15 The transducer 2 of these figures has a pair of spaced magnets 6, 8 at least partially forming a tunnel 10. The tunnel having a central axis 12. The transducer 2 further has a coil 14 at least partially forming the tunnel 10. The coil has a first and a second side wall 16, 18 and an upper and lower wall 20, 22. The transducer 2 further has a reed 24 having a central portion 26 which extends
20 through the tunnel 10, a stationary end 28, and a deflection end 30. The reed 24 has a tip portion 30 which lies at least partially between the magnets 6,8. The reed 24 is mounted for deflection towards and/or away from the respective magnets 6, 8.

The coil 14 has a first end 32 toward the stationary end 28 of the reed
25 24 and a second end 34 toward the magnets 6,8. The side walls 16, 18 of the coil 14 are tapered inwardly toward the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal

deflection of the reed 24. Alternatively, the side walls 16, 18 of the coil 14 can be tapered outwardly away from the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24.

Alternatively, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered outwardly away from the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Likewise, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered inwardly toward the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. For the above alternatives or other alternatives, having a coil wall, or any part or stretch thereof, that is tapered, the coil wall can further have a separate raised portion toward the central axis 12, in relation to the adjacent portion of the wall thereof.

Some of the Figures depict dimensions which can be used for the present invention. Other dimensions can be used as well. For the embodiments in Figures 1 through 5, one set of dimensions are as follows: the nominal lateral reed clearance is (.0625"/1.59mm) (nominal tunnel width) - (.0595"/1.51mm)(nominal reed width) = (.003"/.076mm) or (.0015"/.038mm) per side. Coil tunnel taper is (.0045"/.11mm) over (.093"/2.4mm) length, or about 2.8°. The nominal reed to rib (top or bottom of the coil) is (.0111"/.282mm) (nominal rib gap) - (.008"/.2mm) (nominal reed thickness) = (.0031"/.079mm), or (.0015"/.039mm) top / bottom.

Figure 6 is a front view of a further coil winding bobbin for a transducer 2 of the present invention. Figure 7 is a back view of the coil winding bobbin of Figure 6. Figure 8 is a side view of the coil winding bobbin of Figure 6. Figure 9 is a top view of the coil winding bobbin of Figure 6. These figures show one tapering that can be implemented within the coil winding for the present invention.

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Figures 14, 15, and 16 show further embodiments of the transducer 2 of present invention. The upper and lower tunnel walls 40, 42 of the magnets 6,8 have a raised portion 80 inwardly toward the central axis 12 toward the first end 46 of the magnets 6,8. The raised portion 80 can extend substantially the width of the tunnel, as shown in Figure 15, or less than the entire width, as shown in Figure 16. It should be understood that the raised portion can be provided at or along other areas of the upper and/or lower tunnel walls 40, 42.

Figures 17 and 18 show further embodiments of the transducer of the present invention. The transducer 2 has a housing 4. An armature 90 has a reed 92, and a first leg 94 and a second leg 96 extending along opposed sides of the exterior of a coil 14 and a yoke 60. Spacers 100, which can be comprised of a resilient epoxy or RTV, are position between the housing 4 and the first and second legs 94, 96 of the armature 90. Figure 18 shows that another spacer 100 can be positioned between the housing 4 and the armature 90 adjacent the stationary end of the reed 92.

Active shock protection means 104 of the armature's reed 24 can be incorporated as an alternative to the spacers 100. The shock protection means 104 is idle until a shock is absorbed by the transducer 2. FIGURE 19 is a front view of an alternative embodiment of the present invention having shock protective means 104. The shock protective means 104 comprises a pair of bumpers 110 on opposing sides 120, 122 of a reed 24. The shock protective means 104 will reduce and prevent unwanted movement of the reed 24 caused by a shock impulse. Under normal conditions, the active bumpers 110 remain out of contact with the reed 24 as depicted in FIGURE 19. As the transducer 2 receives a shock impulse, the active bumpers 110 will engage the reed 24 to prevent damage by clamping or inhibiting the reed 24 from movement.

Preferably, the shock protective means 104 includes a ring 106, preferably metal, circumferentially positioned about the central axis 12 of the tunnel 10. The ring 108 has opposing upper 120 and lower 122 walls; and opposing side walls 116, 118. Extending from the upper 120 and lower 122 walls of the ring 106 and toward the armature's reed 24 is a bumper 110. Each bumper 110 is attached to the upper 120 and lower 122 wall of the ring 106 by a flexible band 126, preferably made of flurosilicon. The flexible band 126 may be molded directly onto the ring 106 and the bumpers 110 by Flexan (TM). The bumpers 110 remain away from the reed 24 until the transducer 2 encounters a vertical shock impulse.

As the transducer 2 receives a vertical shock impulse, the protective bumpers 110 of the shock protective means 104 respond to the vertical shock impulse and move to engage the reed 24. FIGURE 20. It is to be understood that although the present embodiment discloses the active shock protective means 104 as having a pair of bumpers 110 on opposing sides 120, 122 of the reed, the present invention includes alternative embodiments having at least one bumper 110 in close proximity to the reed 24 so as to engage the reed 24 in response to a shock impulse. Another alternative embodiment shown in FIGURE 23 depicts shock protective means 104 having a molded flexible gasket 112.

The active shock protective means 104 can be positioned between the stack and the coil 14. FIGURE 21. Alternatively, the active shock protective means 104 can be positioned at the end of stack near the deflection end 30 of the reed 24. FIGURE 22.

While the specific embodiments have been illustrated and described, numerous modifications come to mind without significantly departing from the spirit of the invention and the scope of protection is only limited by the scope of the accompanying claims.

CLAIMS

WE CLAIM:

1. A transducer comprising:
 - a stack having a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;
 - a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;
 - a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the magnets; and,
 - shock protective means wherein the protective means is responsive to a shock impulse to the transducer where upon the protective means engages the reed.
2. The transducer of claim 1 wherein the shock protective means comprises:
 - a ring fixedly attached between the coil and the stack; and,
 - at least one bumper attached to the ring in close proximity to the reed, wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.
3. The transducer of claim 1 wherein the shock protective means comprises:
 - a ring fixedly attached between the coil and the stack;
 - a first and second bumper, the first bumper is attached to the upper wall of the ring and the second bumper is attached to the lower wall of the ring, wherein the

bumpers are responsive to an impulse shock to the transducer and the bumpers act to contact the reed.

4. The transducer of claim 2 wherein the ring is a metal.
5. The transducer of claim 3 wherein the ring is a metal.
6. The transducer of claim 1 wherein the shock protective means comprises:
a ring fixedly attached to the stack near the deflective end of the reed; and,
at least one bumper attached to the ring in close proximity to the reed, wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.
7. The transducer of claim 1 wherein the shock protective means comprises:
a ring fixedly attached to the stack near the deflective end of the reed; and,
a first and second bumper, the first bumper is attached to the upper wall of the ring and the second bumper is attached to the lower wall of the ring, wherein the bumpers are responsive to an impulse shock to the transducer and the bumpers act to contact the reed.
8. The transducer of claim 6 wherein the ring is a metal.
9. The transducer of claim 7 wherein the ring is a metal.
10. A transducer comprising:

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, and wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets.

11. The transducer of claim 10 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

12. The transducer of claim 10 wherein at least one side wall of the coil is tapered outwardly from the central axis from the first end of the coil to the second end of the coil.

13. The transducer of claim 12 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

14. The transducer of claim 10 wherein at least a part of at least one side wall of the coil is tapered outwardly away from the central axis from a position closer to the first end of the coil than the second end of the coil, to a position closer to the second end of the coil than the first end of the coil.

21. The transducer of claim 19 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

22. The transducer of claim 10 wherein at least a stretch of at least one side wall of the coil is tapered outwardly from the central axis moving toward the second end the coil, the stretch being located toward the second end of the coil.

23. The transducer of claim 22 wherein the at least a stretch of at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

24. The transducer of claim 10 wherein a stretch of at least a part of one or both of the upper and lower walls and at least one side wall of the coil is tapered outwardly from the central axis moving toward the second end the coil, the stretch being located toward the second end of the coil.

25. The transducer of claim 24 wherein the stretch of at least a part of one or both of the upper and lower walls further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

26. The transducer of claim 24 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

27. A transducer comprising:

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

28. The transducer of claim 27 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets.

29. The transducer of claim 28 wherein the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

30. The transducer of claim 27 wherein at least a stretch of at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets.

31. A transducer comprising:
a pair of spaced permanent magnets at least partially forming a tunnel, the tunnel having a central axis;

a first and second yoke portion;

at least one shim between one yoke portion and one of the pair of spaced apart magnets;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

32. The transducer of claim 31 wherein at least a stretch of the at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets, the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

33. The transducer of claim 31 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets, the tapering being caused by the tapering of the at least a part of one of the first and second yoke portions being tapered along the side of the yoke portion adjacent the one of the pair of magnets.

34. A transducer (2) comprising a pair of spaced magnets (6,8) at least partially forming a tunnel (10), the tunnel (10) having a central axis (12), the

35. The transducer of claim 34 wherein the raised portion extends substantially the width of the tunnel.

a housing;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;

AMENDED SHEET

magnets, the armature further having a first leg and a second leg extending along opposed sides of the exterior of the coil and the magnets; and, an at least one spacer for securing the armature to the housing.

37. The transducer of claim 36 wherein the at least one spacer is positioned between the housing and one of the first and second legs of the armature.

38. The transducer of claim 36 wherein the at least one spacer is positioned between the housing and the armature adjacent the stationary end of the reed.

ABSTRACT OF THE DISCLOSURE

A transducer comprising a pair of spaced magnets at least partially forming a tunnel having a central axis. A coil having a first and a second side wall and an upper and a lower wall at least partially forms the tunnel. A reed having a central portion extends through the tunnel. The reed has a stationary end, a deflection end, and a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets.

(107674 1)

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FIG.1

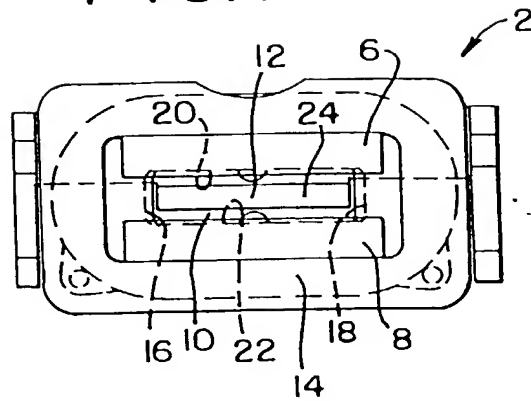
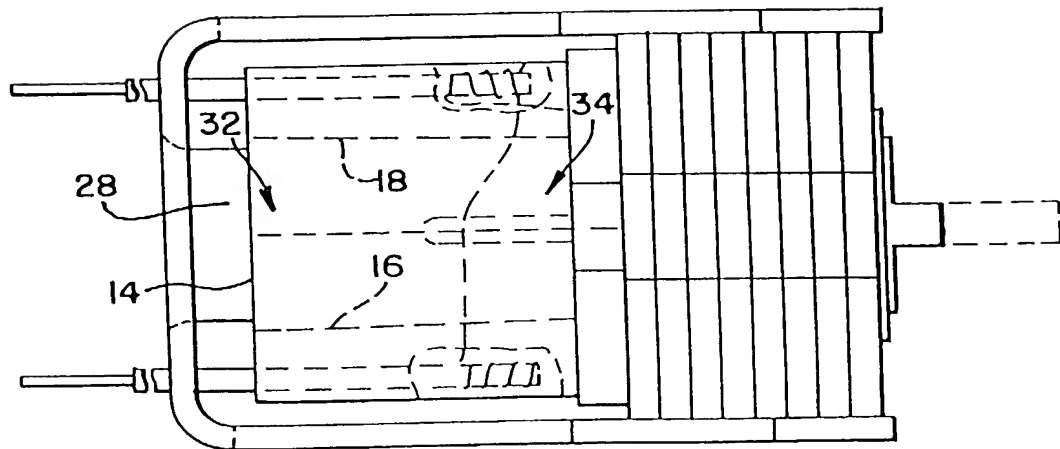


FIG.2



2/7

FIG.4

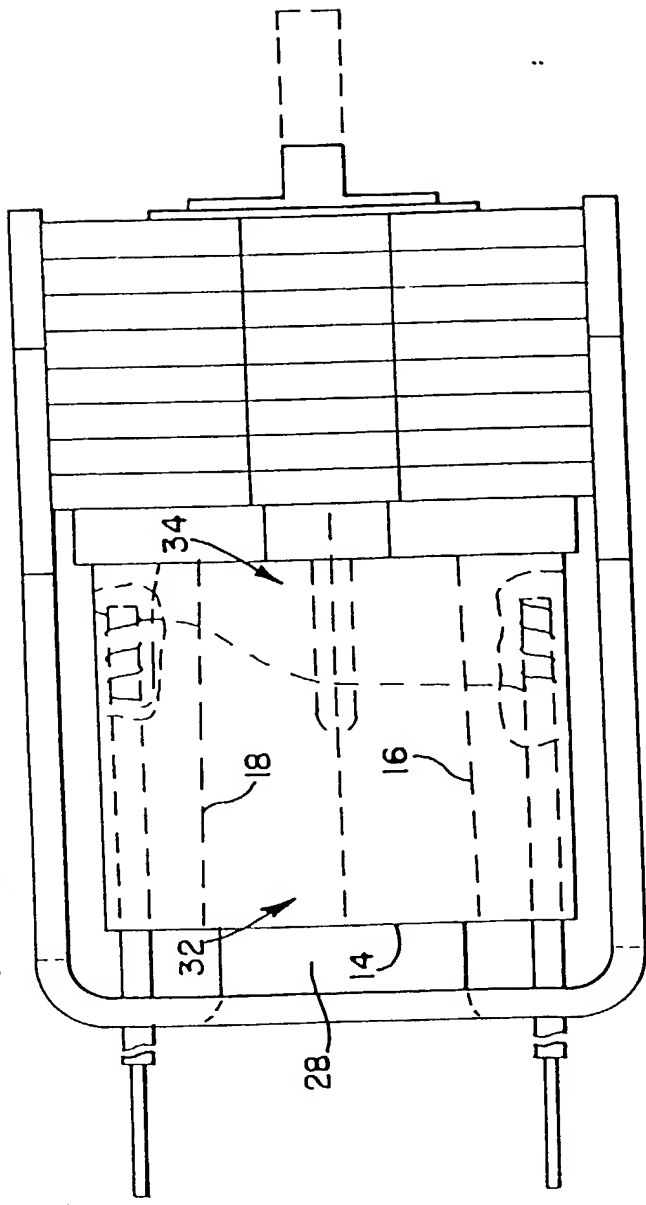


FIG.3

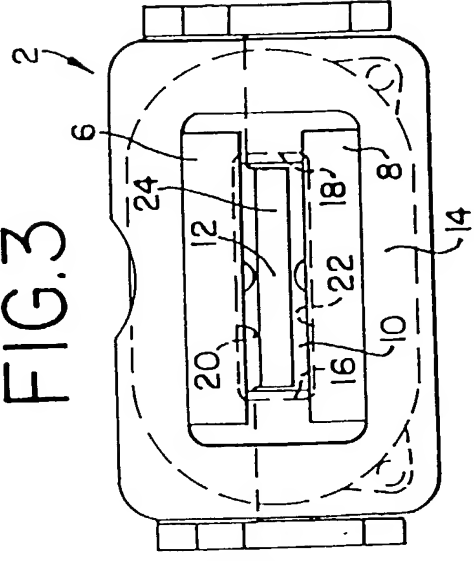
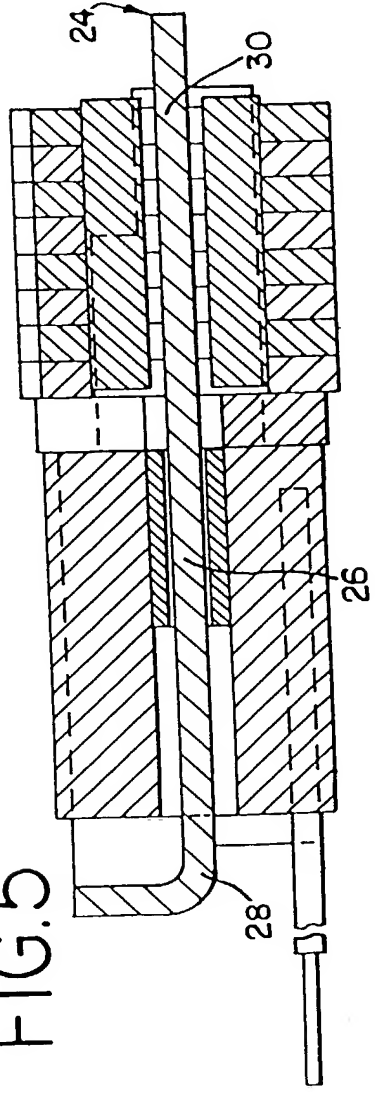


FIG.5



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FIG.6

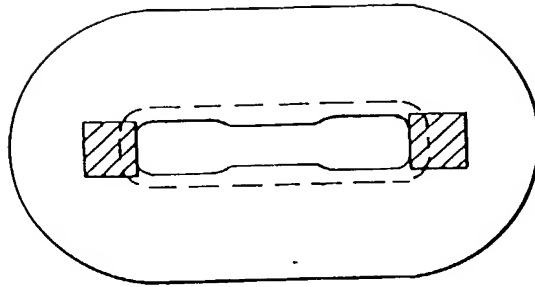


FIG.7

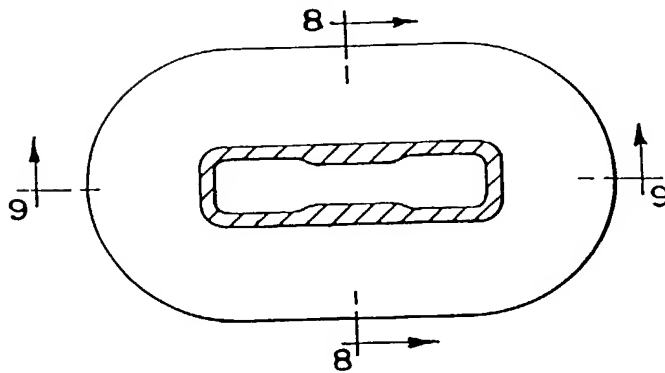


FIG.8

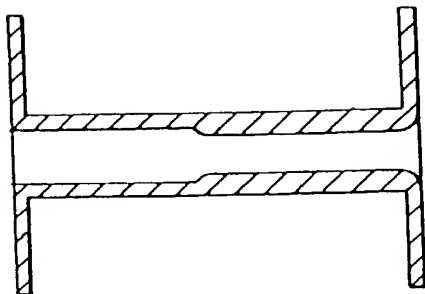


FIG.9

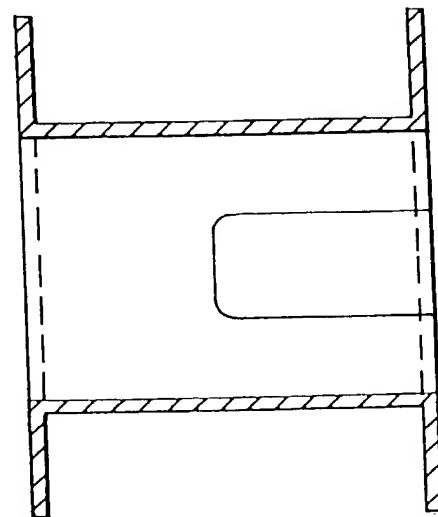


FIG. 10

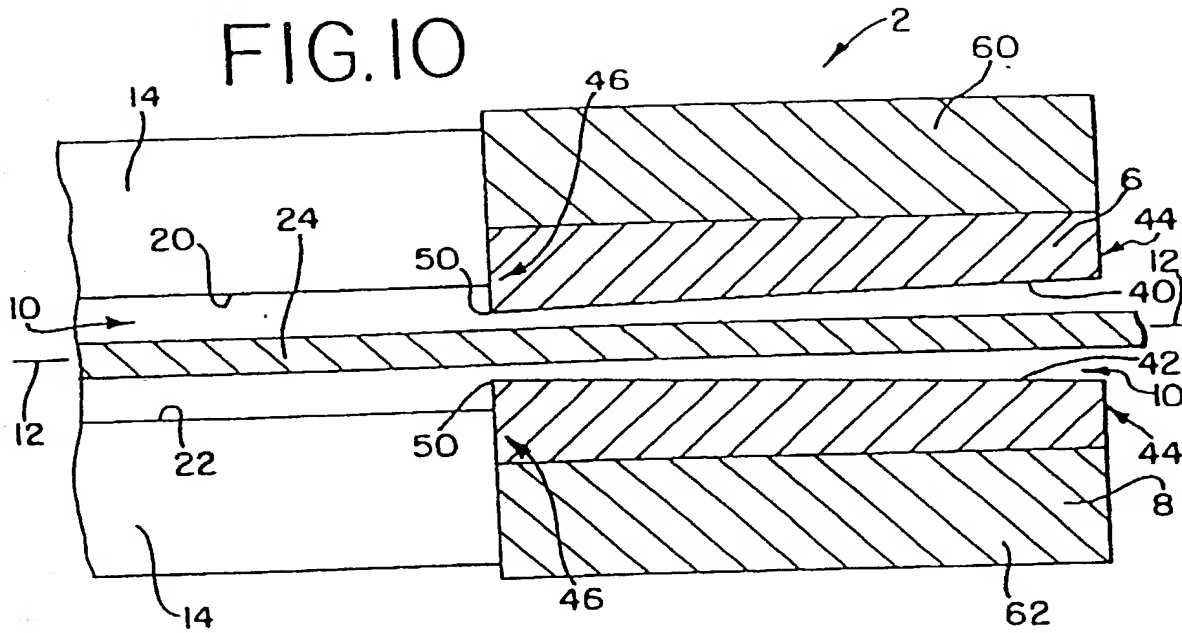


FIG. 12

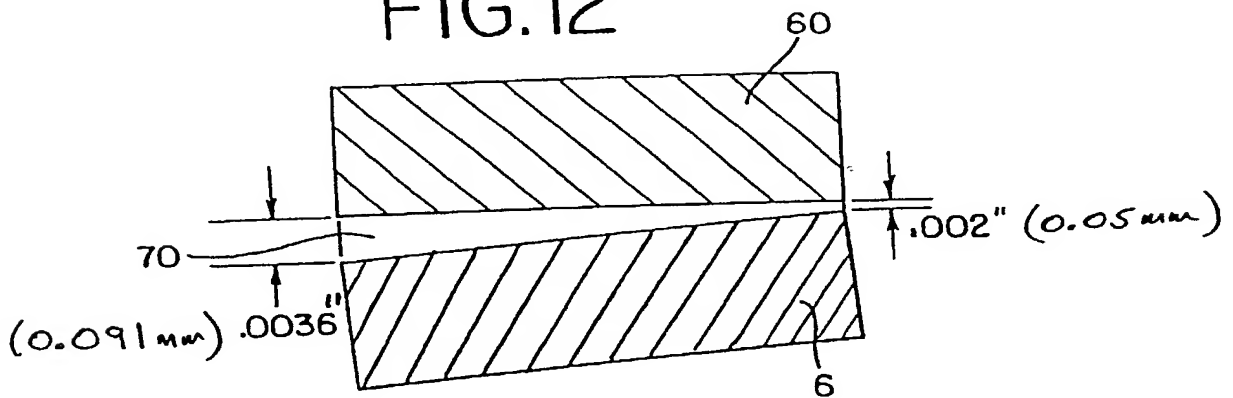


FIG. 11

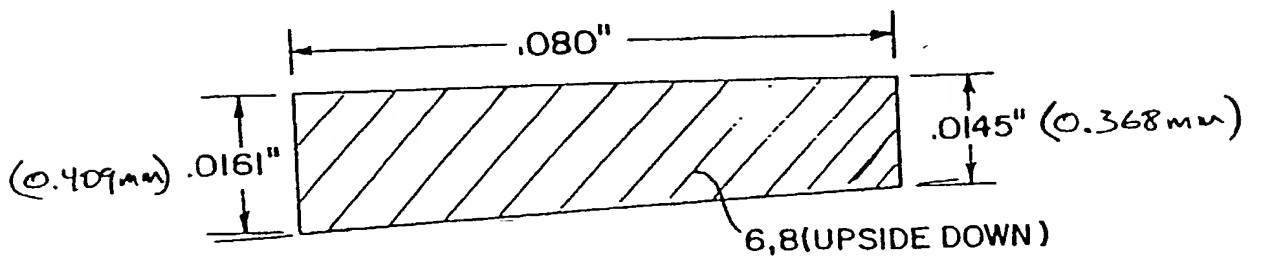


FIG. 13

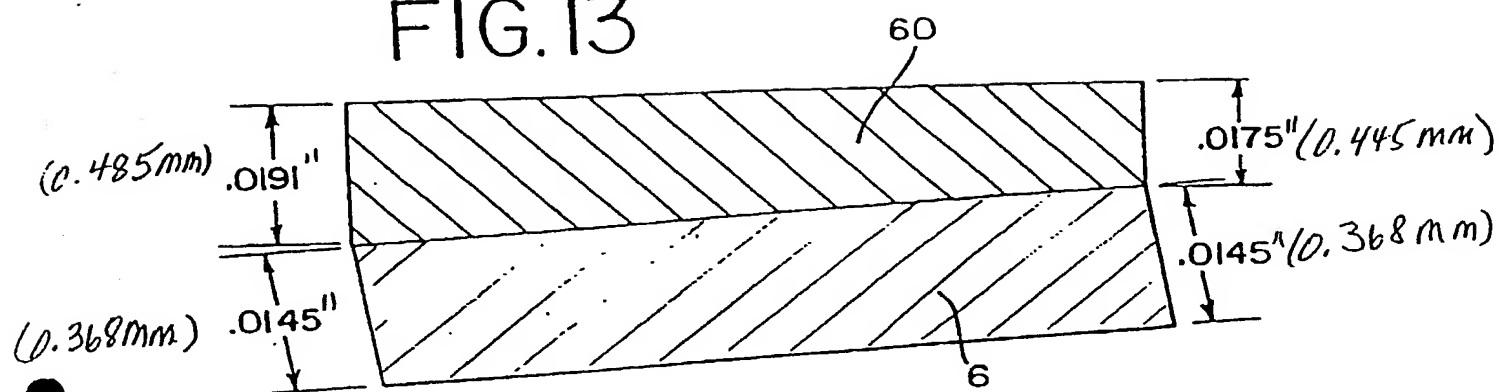


FIG. 14

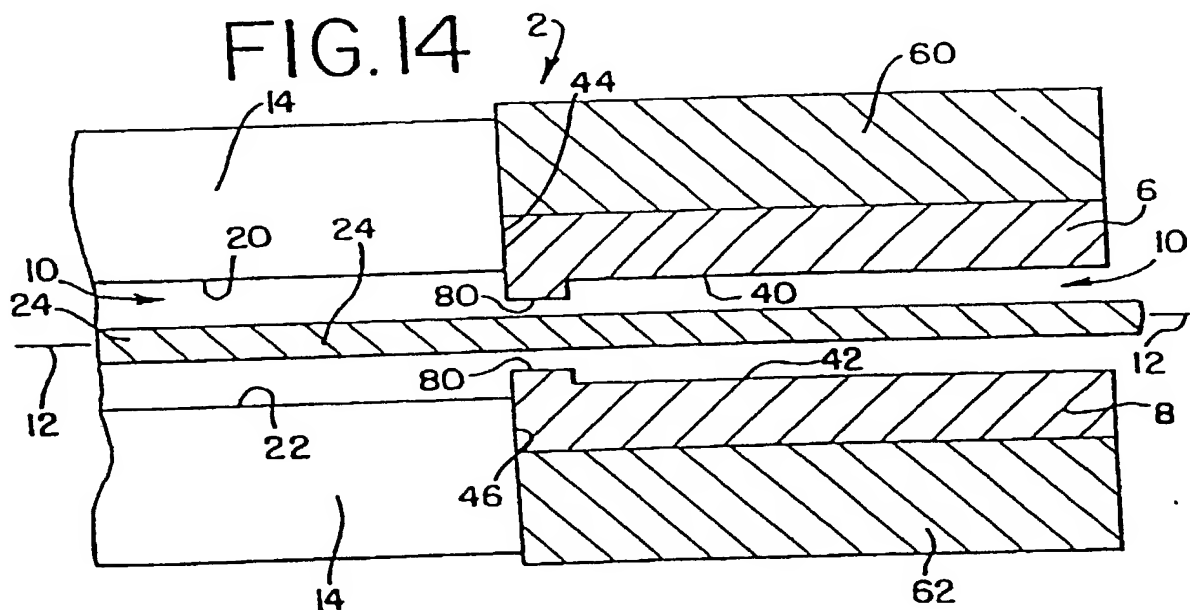


FIG. 15

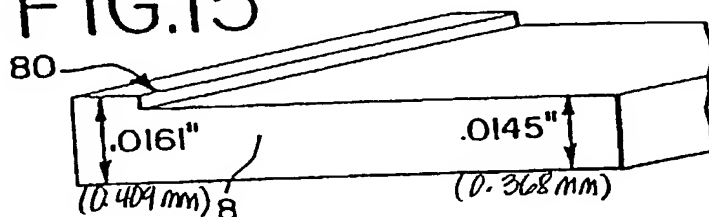
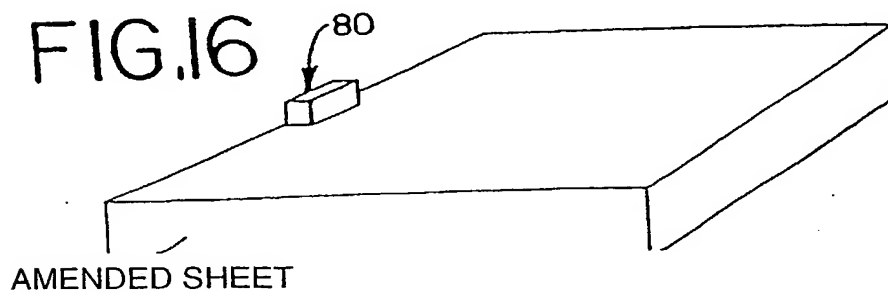


FIG. 16



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FIG.17

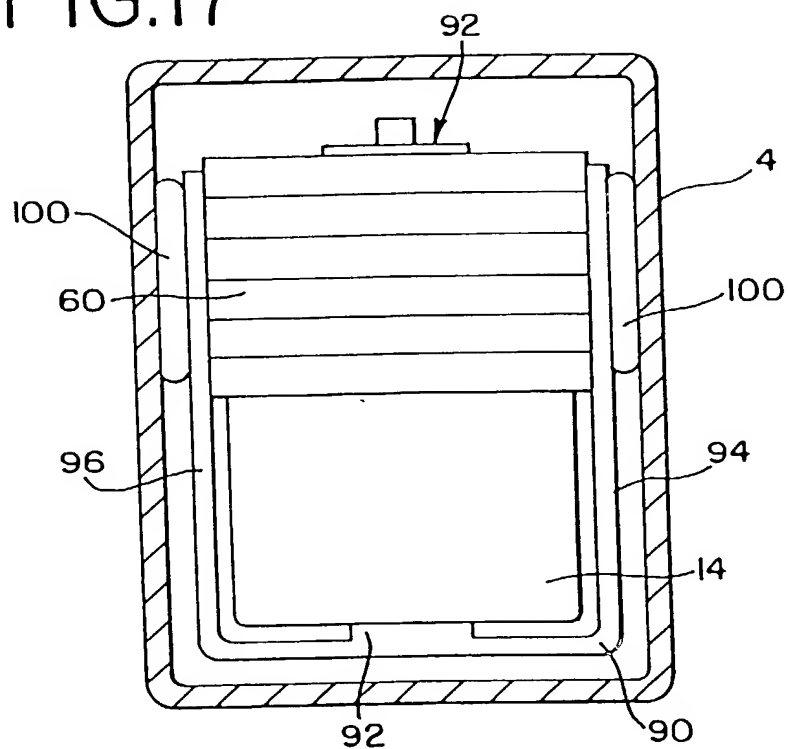
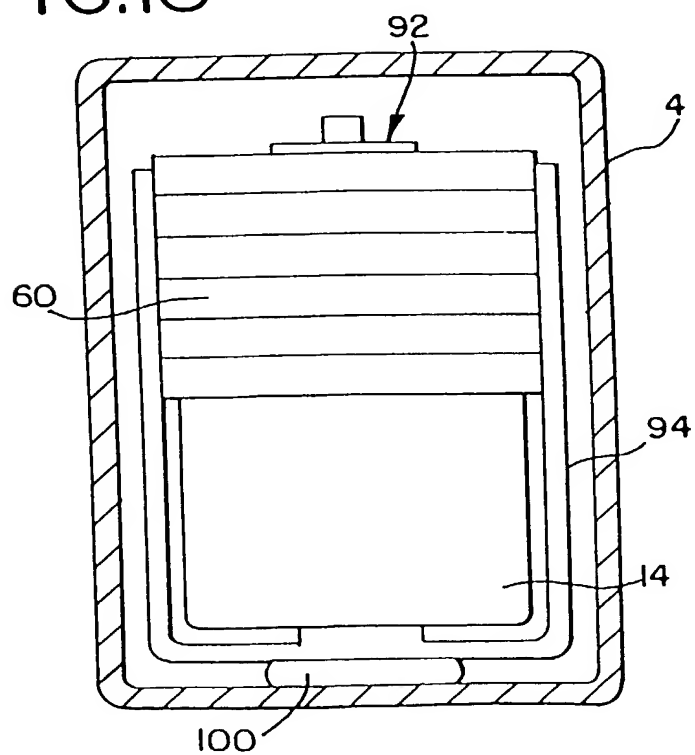


FIG.18



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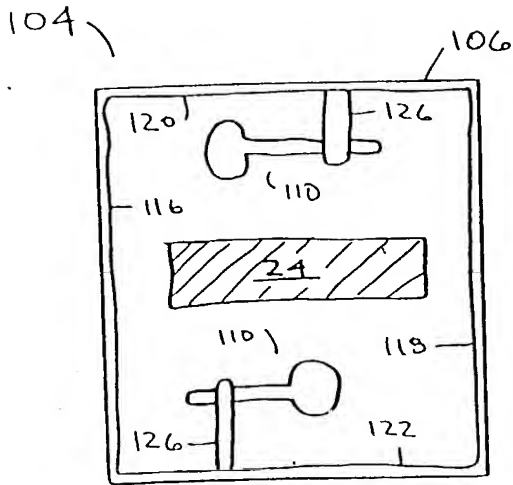


FIGURE 19

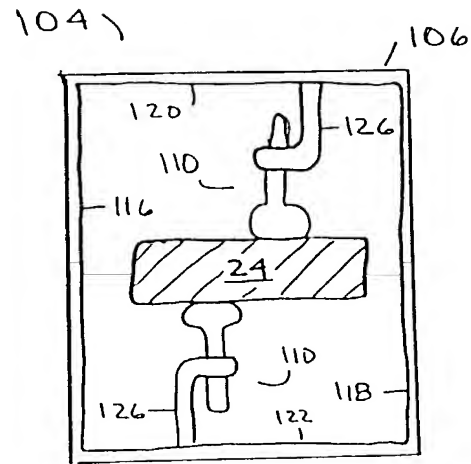


FIGURE 20

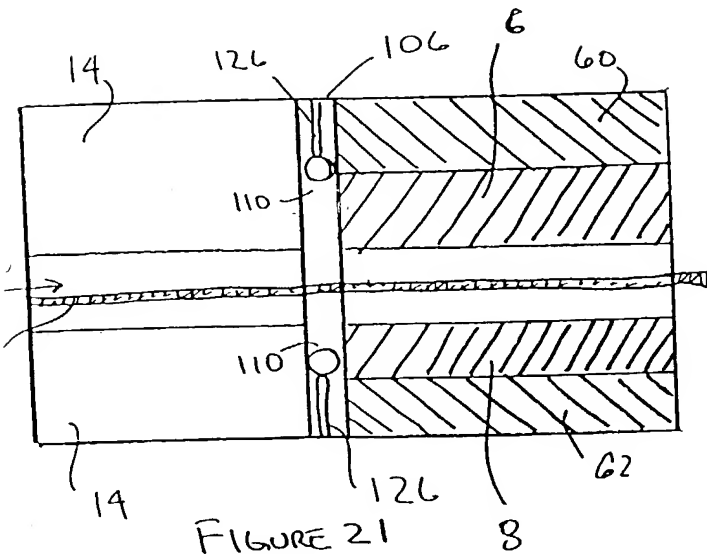


FIGURE 21

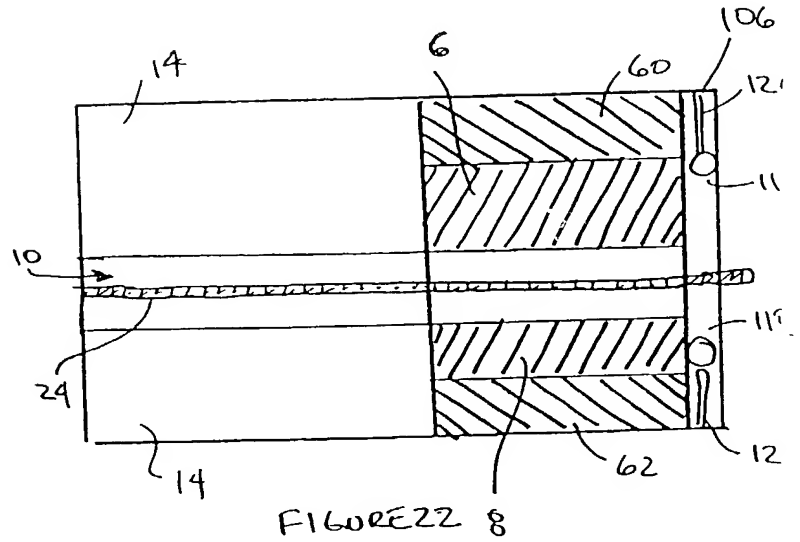


FIGURE 22

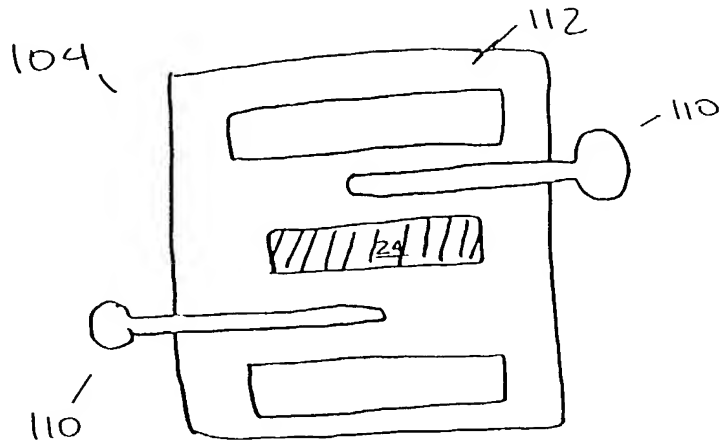


FIGURE 23

Attorney Docket No. 328 P 653

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

DECLARATION

As below-named Inventors, We declare that our residences, citizenship and post office addresses are as stated below next to our names; that We believe We are the original, and joint Inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SCHOCK-WAVES"
the specification of which is attached hereto. We hereby state that we have reviewed and understand the contents of the above-identified specification, including the Claim, as amended by any amendment referred to above. We acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application the national or PCT international filing date of the continuation-in-part application.

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this Application and transact all business in the Patent and Trademark Office connected therewith:

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We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these

statements were made with the knowledge that willfully false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willfully false statements may jeopardize the validity of the application or any patent issued thereon.

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